PIPE BURYING METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a pipe burying method for burying a pipe such as a water pipe, a gas pipe, a drain pipe, a sheath pipe for a signal cable, and a fiber cable or the like (hereinafter, referred to as "a buried pipe") in the earth.

Description of the Related Art

A pipe burying method for burying a pipe such as a water pipe, a gas pipe, a drain pipe, a sheath pipe for a signal cable, and a fiber cable or the like (hereinafter, referred to as "a buried pipe") in the earth is roughly divided into a drive construction method for driving the earth and burying a pipe, and a non-drive construction method for burying a pipe without driving the earth. The both construction methods have an advantage and a disadvantage, respectively. In other words, as compared to the drive construction method, the non-drive construction method has an economical advantage such that a pipe can be easily buried as crossing under an orbit of a railroad and a river or the like and a pipe can be buried while preserving the environment, and further, the non-drive construction method is a short construction schedule. Further, according to the

drive construction method, a so-called power shovel or the like is used; however, according to the non-drive construction method, a horizontal drill is used. This horizontal drill has a two process system including a pilot excavation, enlargement of a diameter, and retracting a buried pipe, and the present invention relates to a reamer apparatus which is used for a ground boring machine to be used in this two process system.

In the case of burying a buried pipe with a horizontal drill construction, as shown in FIG. 10, at first, a penetration pit P1, a starting pit P2, and an attainment pit P3 are formed on the earth at certain intervals each other. In the vicinity of the penetration pit P1, a drilling fluid feeder 101 and a drill driving device 102 (constructing a horizontal drill) are disposed. Then, a buried pipe 104 is disposed in the vicinity of the attainment pit P3, of which length approximately equivalents to a distance from the starting pit P2 to the attainment pit P3. This is a preparation operation. In the meantime, the drill driving device 102 is defined to be freely promote in the earth as adding a plurality of hollow rods 105, and further, on the contrary, the drill driving device 102 is defined to be freely pulled out from the earth as adding a plurality of hollow rods 105. The drilling fluid feeder 101 stores a drilling fluid such as a crystal water, a muddy water, a bentonite muddy water or the like therein and at the same time, the drilling fluid feeder 101 can freely pressure feed the

stored drilling fluid into a hollow of the hollow rod 105 which is disposed on the drill driving device 102 via a hose 107.

Therefore, on the drill driving device 102, the first hollow rod 105 is installed to be supported. At a front end of this hollow rod 105, for example, a leading body (a pilot head) 105a with an outer diameter of about 70 to 100 mm is fit in advance. In the meantime, for example, an outer diameter of the hollow rod 105 is about 40 to 50 mm. Then, by means of the drill driving device 102, the first hollow rod 105 penetrates through the penetration pit P1 obliquely at a penetration angle β (nearly equal to 15°) if the earth is approximately horizontal; the first hollow rod 105 is promoted in an arrow direction A1 toward the starting pit P2 without no rotation while rotating the hollow rod 105; and bending it horizontally, a pilot hole 108 is formed in the starting pit P2. Further, as adding the hollow rods 105 to the attainment pit P3 via the starting pit P2, the hollow rods 105 are promoted in the earth in an arrow direction A2.

In other words, in the case of drilling and making a linear hole, while rotating the oblique leading body 105a that is fit to this rod front end by means of a rotational motor 130 of the drill driving device 102 via the rod 105, the rotational motor 130 is promoted along a frame 131. In addition, in the case of changing a direction (in the case of drilling and making a curved hole), the rotational motor 130 is not rotated but

stopped, and under this state, the rotational motor 130 is promoted along the frame 131 (the rod 105 is promoted). Then, making an obliquely-cut surface of the oblique leading body 105a to act on the earth pressure, the direction of the oblique leading body 105a is changed to the opposite direction of the oblique-cut surface to be promoted. Thus, by promoting the rod 105, the curved hole is drilled so that the oblique leading body 105a attains to the attainment pit P3. In the meantime, the pilot head 105a has a plurality of nozzle holes (illustration thereof is omitted) communicating through the hollow of the hollow rod 105. Therefore, upon promoting the pilot head, the drilling fluid that is pressure-fed from the drilling fluid feeder 101 is emitted backward so as to discharge the drilling fluid and the drilled earth and sand backward.

Then, when the leading body (the pilot head) 105a protrudes in the attainment pit P3, the pilot hole 108 is completed. Then, the pilot head 105a is removed. Then, a reamer apparatus provided with a reamer (a diameter enlarging device) is fit, which reamer has a diameter approximately identical with or slightly larger than a pipe diameter of the buried pipe 104.

As a conventional reamer of this reamer apparatus, there is a cone-shaped one, namely, a so-called fusiform-shaped one corresponding to pebbles and gravel-blended earth (for example, refer to JP-A 2001-73440 (pages 6-9, FIG. 1)). As shown in FIG.

12, a reamer 109 of this reamer apparatus is provided with a spiral groove 109b at its outer peripheral surface and a plurality of nozzle holes 109a communicating through the hollow of the hollow road 105. Then, connecting a Swivel joint 110 to the front end of the reamer 109 and connecting a pipe joint (a so-called "towing head") 111 at a front end of the Swivel joint 110, the front end of the pipe joint 111 is connected to the front end of the buried pipe 104.

Thus, after fitting the reamer apparatus between the hollow road 105 and the buried pipe 104, the hollow rod 105 is retracted into a direction of an arrow B2 shown in FIG. 11 while rotating the hollow rod 105 by means of the drill driving device 102. The earth and sand generated in this time is discharged from a space between the pilot hole 108 and an outer diameter of the rod by emitting the drilling fluid. In addition, a part of the drilling fluid comes round to a rear side to carry out a roll of a lubricant for the buried pipe 104. Then, the cut earth is confined in an inner wall of a hole at an outer periphery of the reamer 109 by rotation and retracting of the reamer 109, and thereby, the diameter of the pilot hole 108 is enlarged and the buried pipe 104 is retracted in the enlarged hole to be formed along the direction of the arrow B1. Thus, the above-described drilling fluid is used for discharging the drilled earth and sand, lubrication and cooling of the oblique leading body (pilot head) 105a or the reamer 109, and smooth promotion of the rod

105, and further, the bentonite fluid is used for preventing the earth and sand from falling in a drilled hole and improving a pressure density for the wall of the drilled hole.

Then, when the hollow rod 105 is retracted till the front end of the buried pipe 104 protrudes in the starting pit P2, it is possible to set the buried pipe 104 between the attainment pit P3 and the starting pit P2 if the reamer device is detached from the buried pipe 104 and the hollow rod 105 in the starting pit P2. Then, the hollow rod 105 is pulled out from the penetration pit P1. In addition, when the buried pipe 104 is buried for a long distance, the pipe burying operation in the above-described series of processes will be repeated.

In the meantime, depending on a place where the buried pipe 104 is buried, various types of soil such as a soft soil, a hard soil, a viscous soil, and a sandy soil or the like are observed. Therefore, when the same reamer is used, depending on the soil type, the diameter of the pilot hole 108 sometimes cannot be enlarged efficiently. For example, since the viscous soil has small falling property (falling of earth and sand into the hole with the enlarged diameter), a height of a drilling blade can be made large, however, in order to decrease a friction resistance, it is necessary to make a blade width of the drilling blade small. In addition, since the sandy soil has a large falling property, it is necessary to make a blade height of the drilling blade small (in this case, if the height of the drilling

blade is made low, an amount of drilling is made small). In addition, in the soft soil, a reamer having a large blade width and a high blade height can be used, however, if the blade width is large in the soft soil, the friction resistance becomes large, so that the reamer itself is damaged or a large rotation driving force is needed. Therefore, it is preferable that the reamer having the large blade width and the high blade height is used in the soft soil, the reamer having the small blade width and the high blade height is used in the viscous soil, and the reamer having the large blade width and the low blade height is used in the sandy soil.

SUMMARY OF THE INVENTION

The present invention has been made taking the foregoing problems into consideration and an object thereof is to provide a pipe burying method by which a diameter of a pilot hole can be efficiently and reliably enlarged depending on various types of soil and a burying operation of a buried pipe is made stable.

According to a first aspect of the present invention, a pipe burying method is used for burying a buried pipe 1 in the earth by using a reamer 6 having a reamer main body 8 that is approximately cone-shaped, of which diameter is contracted toward the side into which it is retracted, and a platy member 9 to be annexed to the outer surface of this reamer main body 8 and to form a drilling part, and the method includes the steps

of preparing various types of platy members 9, selecting a platy member 9 suitable for a soil type from among the various types of platy members 9 on the basis of a soil type search of a burying place, attaching the selected platy member 9 to a reamer main body 8 to form a reamer 6 suitable for the soil type, annexing this reamer 6 at a front end of a rod 3 in a pilot hole 5 in the earth; pulling out this rod 3 from the pilot hole 5 while rotating the reamer 6 together with the rotation of the rod 3, and burying a buried pipe 1 to be connected to the reamer 6 in the earth.

According to the pipe burying method of the first aspect, since the reamer 6 is suitable for a soil type of a burying place where the pilot hole 5 is formed, the reamer 6 can drill the earth by the drilling amount corresponding to the soil type and evading falling of earth and sand into the hole with the enlarged diameter after enlarging the diameter, the reamer 6 can smoothly carry out the retracting operation of the buried pipe 1. In addition, preventing excess load and friction force from being given to a drilling blade of the reamer 6, the damage of the reamer 6 can be prevented. Thereby, the used reamer 6 can be used stably for a long time. Further, by changing a platy member 9 to be attached to a reamer main body 8, various types of reamer 6 can be formed and this makes it possible to form the reamer 6 easily corresponding to a soil property of the burying place. In this case, since the reamer main body 8 can be shared, a cost

can be decreased and stock control becomes simple. In the mean time, in the case of forming the reamer 6, the platy member may be attached to the reamer main body 8 at a scene of burring, or before going to the burying scene, the platy member 9 suited for the soil type of this burring scene may be attached to the reamer main body 8 so as to form the reamer 6 that is suited for the soil type. If the platy member 9 is attached to the reamer main body 8 at the burying scene, even if the soil type at the burying scene is different from the soil type that was inspected in advance, by attaching the platy member 9 to the reamer main body 8 at this burying scene, it is possible to form the reamer 6 that is suited for the soil type. In addition, if the platy member 9 is attached to the reamer main body 8 before going to the burying scene, it is possible to omit the attachment operation (operation such as welding or the like) at the burying scene and the burring operation time can be shortened. Further, since there is no necessity to bring a welding device or the like to the scene, an operator can easily move to the scene.

According to a second aspect of the present invention, a pipe burying method is used for burying a buried pipe in the earth by using a reamer 6, and the method includes the steps of preparing various types of reamers 6, selecting a reamer 6 suitable for a soil type from among the various types of reamers 6 on the basis of a soil type search of a burying place, annexing the selected reamer 6 at a front end of a rod 3 in a pilot hole

5 in the earth, pulling out this rod 3 from the pilot hole 5 while rotating the reamer 6 together with the rotation of the rod 3, and burying a buried pipe 1 to be connected to the reamer 6 in the earth.

According to the pipe burying method of the second aspect, since the reamer 6 that is suited for a soil type of the burying place among plural types of reamer 6 at the burying scene, by using the reamer 6 in accordance with various types of soil, the diameter enlargement operation of the pilot hole 5 can be carried out and this leads to the stable pipe burying operation.

According to a third aspect of the present invention, in the pipe burying method, the reamer 6 has a reamer main body 8 that is approximately cone-shaped, of which diameter is contracted toward the side into which it is retracted, and a platy member 9 to be annexed to the outer surface of this reamer main body 8 and to form a drilling part, and various types of reamers are formed by changing this platy member 9.

According to the pipe burying method of the third aspect, since various types of reamer 6 can be formed by changing the platy member 9 to be attached to the reamer main body 8, it is possible to simply form the reamer 6 that is suited to the soil type of the burying place. In addition, also in this case, if the platy member 9 is changed, different types of reamer 6 can be formed, so that the reamer main body 8 can be shared. Thereby, the cost can be decreased and the stock control can be simply

carried out.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified view showing an embodiment of a pipe burying method according to the present invention;

FIG. 2 is a simplified view showing a method for forming a pilot hole;

FIG. 3 is a cross sectional view of a reamer device of a ground boring machine to be used for the pipe burying method;

FIG. 4 is a side view showing a reamer of the reamer device;

FIG. 5 is a front view showing a reamer of the reamer device;

FIG. 6 is a substantial part enlarged cross sectional view of the reamer device;

FIGS. 7A and 7B are substantial part enlarged cross sectional views of the reamer of the reamer device;

FIGS. 8A and 8B are rear views of a reamer main body of the reamer device;

FIGS. 9A to 9E are cross sectional views showing a platy member of the reamer device;

FIG. 10 is a simplified view showing a method for forming a pilot hole by the ground boring machine;

FIG. 11 is a simplified view showing a pipe burying method of a buried pipe by the ground boring machine; and

FIG. 12 is a simplified view showing a conventional reamer

device of the ground boring machine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following, with reference to the drawings, embodiments of the pipe burying method according to the present invention will be described in detail below. In this pipe burying method, the above-described horizontal drill construction is employed and a ground boring machine shown in FIGS. 1 and 2 is used. According to the pipe burying method, at first, a pilot hole 5 as shown in FIG. 2 is formed. This pilot hole 5 is formed by the above-described operation shown in FIG. 10 and this operation will be briefly described below with reference to FIG. 1. At first, as shown in FIG. 2, a penetration pit P1, a starting pit P2, and an attainment pit P3 are formed on the earth at certain intervals each other. Then, on a drill driving device 2, a rod (a hollow rod) 3 with a leading body (a pilot head) 3a fit at its front end is installed to be supported. Then, while emitting the drilling fluid (a crystal water, a muddy water, and a bentonite muddy water or the like) that is pressure-fed from a drilling fluid feeder 4 from the leading body 3a, by means of the drill driving device 2, the this hollow rod 3 penetrates through the penetration pit P1 obliquely at a penetration angle β (for example, about 15°) if the earth is approximately horizontal; the hollow rod 3 is promoted in an arrow direction A1 toward the starting pit P2

without no rotation while rotating the hollow rod 3; and bending it horizontally, the pilot hole 5 is formed in the starting pit P2. Further, as adding the hollow rods 3 to the attainment pit P3 via the starting pit P2, the hollow rods 3 are promoted in the earth in an arrow direction A2. In other words, in the case of drilling and making a linear hole, while rotating a leading body (an oblique leading body) 3a that is fit to this rod front end by means of a rotational motor 81 of this drill driving device 2 via the rod 3, the rotational motor 81 is promoted along a frame 82. In addition, in the case of changing a direction (in the case of drilling and making a curved hole), the rotational motor 81 is not rotated but stopped, and under this state, the rotational motor 81 is promoted along the frame 82 (the rod 5 is promoted). Then, making an obliquely-cut surface of the oblique leading body 3a to act on the earth pressure, the direction of the oblique leading body 3a is changed to the opposite direction of the oblique-cut surface to be promoted. In the meantime, the pilot head 3a has a plurality of nozzle holes (illustration thereof is omitted) communicating through the hollow of the hollow rod 3. Therefore, upon promoting the pilot head, the drilling fluid that is pressure-fed from the drilling fluid feeder 4 is emitted backward so as to discharge the drilling fluid and the drilled earth and sand backward.

Then, when the leading body (the pilot head) 3a protrudes in the attainment pit P3, the pilot hole 5 is completed. Then,

the pilot head 3a is removed. Then, a reamer apparatus provided with a reamer 6 (a diameter enlarging device) is fit, which reamer has a diameter approximately identical with or slightly larger than a pipe diameter of the buried pipe 1. After fitting the reamer apparatus, the hollow rod 3 is retracted into a direction of an arrow B2 shown in FIG. 2 while rotating the hollow rod 3 by means of the drill driving device 2. The earth and sand generated in this time is discharged from a space between the pilot hole 5 and an outer diameter of the rod by emitting the drilling fluid. In addition, a part of the drilling fluid comes round to a rear side to carry out a roll of a lubricant for the buried pipe 1. Then, the cut earth is confined in an inner wall of a hole at an outer periphery of the reamer 6 by rotation and retracting of the reamer 6, and thereby, the diameter of the pilot hole 5 is enlarged and the buried pipe 1 is retracted in the enlarged hole to be formed along the direction of the arrow B1.

In the following, a reamer device to be used for the pipe burying method of this invention will be described below. As shown in FIGS. 3 to 5, the reamer device is provided with the above-described reamer 6, and this reamer 6 is connected to the buried pipe 1 via a coupled structure 7. The reamer 6 is provided with the reamer main body 8 that is approximately cone-shaped, of which diameter is contracted toward the side into which it is retracted, and a plurality of platy members

9 to be attached to the outer surface of this reamer main body 8. In this case, the approximately hollow cone-shaped reamer main body 8 is referred to as an approximately hollow cone-shaped one not only when it is a pure cone shape but also when it is configured by a short cylindrical base end body 8a and a front end taper portion 8b as shown in FIG. 3 or the like, further when a rod connection part 24 to be described later is projected at its front end, and when something (a Swivel joint 34 or the like to be described later) is contained therein. This platy member 9 is configured by a platy member main body 9a and a curing processing part 9b to be provided on the outer surface of this platy member main body 9a as sown in FIG. 7A. Then, this platy member 9 is disposed on the reamer main body 8 from its front end portion to the base end portion so that it is declined to a shaft core of the reamer main body 8 at a prescribed angle. In this case, the platy member 9 is attached (secured) to the reamer main body 8 by welding to be disposed in a spiral formation.

The curing processing part 9b is formed by diffusion of a super hard particle. In the meantime, as the super hard particle, for example, a tungsten carbide or the like of a high melting point metal-based sinter can be used. In this case, since the platy member 9 configures a drilling part, as shown in FIG. 7A, the curing processing part 9b is provided at the side of a cutting blade 10 of the platy member main body 9a and

the side of an outer surface 11 of the platy member main body 9a; however, it may be disposed only at the side of the cutting blade 10 or may be disposed at the side of the outer surface 11. In addition, as shown in FIG. 4 or the like, at the curing processing part 9b at the side of the outer surface 11, cutout parts 12 of a peripheral direction are provided at a prescribed pitch along a longitudinal direction of the platy member 9. These cutout parts 12 become grooves (spaces) for releasing earth and sand upon drilling so as to decrease a friction resistance. In the meantime, in FIGS. 3 to 5 or the like, a reference mark W denotes a welding part and it is provided at the opposite side of the cutting blade 10. In addition, since the drilling part is projected from the outer surface of the reamer main body 8, as shown in FIG. 7B, the drilling part may be formed by burying the super hard chip 90 in the reamer main body 8. In other words, the super hard chip 90 is configured by a main body part 90a projecting (exposed) from the outer surface of the reamer main body 8 and a projection part 90b projecting from this main body part 90a, and this projection part 90b is fit in a hole portion of the reamer main body 8. Then, by this main body part 90a, the drilling part may be formed. In FIG. 7B, a reference numeral 91 denotes a member for preventing a retaining member such as a stop ring or the like.

Thus, by attaching a plurality of platy members 9 to the reamer main body 8, concave grooves 13 are formed between

respective platy members 9. This concave groove 13 becomes a discharge groove of the drilled earth. In addition, at a peripheral wall of the reamer main body 8, a cutout part 14 is disposed at a rear end edge portion of the concave groove 13. This cutout part 14 has a function to discharge the earth and sand entered in the concave groove 13 to the rear side.

Then, in this concave groove 13, a plurality of emission ports 15 for emitting the drilling fluid is disposed along the platy member 9. In this case, a screw hole 16 is provided at the peripheral wall of the reamer main body 8, and a nozzle member 17 is fit in this screw hole 16. A penetration hole of the nozzle member 17 (a penetration hole in a direction approximately orthogonal to the peripheral wall of the reamer main body 8) becomes the emission port 15.

In the meantime, as described above, the reamer main body 8 is configured by the cylindrical base end body 8a and the front end taper portion 8b, the above-described cutout part 14 is formed at the base end body part 8a, and the above-described emission ports 15 are formed at the front end taper portion 8b. Then, at the side of the base end body part 8a of the front end taper portion 8b, a discharge port 18 is provided to discharge the drilling fluid to an oblique rear side. In this case, a penetration hole 19 is formed at the peripheral wall of the reamer main body 8, and a nozzle member 20 is fit to this penetration hole 19. Then, the nozzle member 20 is composed

of a block body 20a and a nozzle 20b to be screwed to this block body 20a.

In the vicinity of the above-described respective emission ports 15 and respective discharge ports 18, projection members 21 are disposed so as to prevent the drilled earth and sand from entering into these ports. In this case, a projection member 21 is defined as a front side of a rotational direction C (refer to FIG. 5) of the reamer 6. This projection member 21 preferably forms a curing processing part to be formed on its surface by the dispersion of the super hard particle. In other words, as same as the above-described curing processing part 9b of the platy member 9, a projection member main body that is not cured may be secured (welded) to the reamer main body 8, and the curing processing part may be provided on the surface of this main body. In the meantime, without using such a main body, the projection member 21 may be formed by a so-called hard facing of the super hard particle and burying of a super hard chip or the like.

Then, as shown in FIG. 3, a disk partition member 22 is fit to an opening part side of a larger diameter of the reamer main body 8. Thereby, a hollow chamber 23 is formed on the reamer main body 8 as a passage into which the drilling fluid is supplied. In addition, on the partition member 22, a shaft member 25 is secured to compose a rod connection part 24 (which is provided at an end portion of a smaller diameter of the reamer

main body 8), to which the rod 3 is connected. The shaft member 25 is composed of a cylinder part 25a projecting from the partition member 22, and a shaft part 25b projecting from this cylinder part 25a; a screw hole 26 is disposed on an end surface of the shaft part 25b; and a through hole 27 opening from this screw hole 26 to the cylinder part 25a is provided. In addition, the cylinder part 25a is provided with a plurality of through holes 28. In this case, the partition member 22 is composed of a center part 22a having a concave portion 29 at the buried pipe side at its shaft core part, and a guard part 22b extending from this center part 22a to an outer diameter direction; and the above-described cylinder part 25a is projected from the rod side of the center part 22a.

Therefore, a screw part (not illustrated) of the rod 3 is screwed to the screw hole 26 of the shaft part 25b, and this reamer 6 is fit to the rod 3. Then, lubricant (the drilling fluid) supplied from the above-described drilling fluid feeder 4 to the rod 3 enters in the cylinder part 25a via a through hole 27 of the shaft part 25b to be supplied from this cylinder part 25a to the hollow chamber 23 via the through hole 28. The drilling fluid entered in this hollow chamber 23 is discharged from respective emission ports 15 and the discharge port 18 to the outside. In the meantime, since the hollow chamber 23 is a passage for supplying the drilling fluid to respective emission ports 15 and the discharge port 18, this passage may

be made of a pipefitting. In addition, according to the above-described embodiment, the rod connection part 24 is composed of the shaft part 25b projecting from an end portion of a smaller diameter of the reamer main body 8; however, the rod connection part 24 may be composed of a part not projecting from the end portion of the smaller diameter of the reamer main body 8. In other words, a screw hole part to which the end portion of the rod 3 is screwed may be disposed in the end portion of the smaller diameter of the reamer main body 8.

As shown in FIG. 8, the above-described partition member 22 is provided with an emission port 36 for emitting the drilling fluid entered in the above-described hollow chamber 23 to the side of the buried pipe (the rear side). In this case, a screw hole 30 is disposed at the partition member 22, and a nozzle member 31 is fit in the screw hole 30. A through hole of this nozzle member 31 becomes an emission port 36. Further, the partition member 22 is provided with a cleaning hole 32 for cleaning the inside of the hollow chamber 23 after using this reamer 6. In this case, the cleaning hole 32 is composed of a screw hole and under a normal usage state, a plug member 33 (refer to FIG. 3) is disposed. In the meantime, the emission port 36 and the cleaning hole 32 are two, respectively in this embodiment; however, the number of them is not limited to two.

As shown in FIG. 3, the coupled structure 7 coupling the reamer 6 and the buried pipe 1 is provided with the Swivel joint

34 and a connection tool 35 for connecting this Swivel joint 34 and the buried pipe 1. As shown in FIG. 6, the Swivel joint 34 is composed of a non-rotation side member S and a rotation side member R; the non-rotation side member S has a shaft part 39 and a holding plate 40 to be secured to this shaft part 39; and the rotation side member R has a base part 37 to be secured to the partition member 22 and a block body 38 to be secured to this base part 37.

The base part 37 is composed of a main body part 37a having a concave portion 41, and a guard part 37b extending in an outer diameter direction from this main body part 37a. Under the state that the main body part 37a is fit in the concave portion 29 of the partition member 22, the guard part 37b is fit in a concave portion for fitting 29a of the guard 22b of the partition member 22. Then, the block body 38 is composed of a ring body and is provided with a through hole 42 and a screw hole 43. In addition, this block body 38 is provided with a protrusion part 44 protruding to the side of the base part 37 and this protrusion part 44 is fit to a peripheral direction cutout area 45 of the base part 37. Under this state, a bolt member 46 to be inserted through the through hole 42 is inserted through a through hole 47 of the base part 37 to be screwed into a screw hole 48 of the guard part 22b of the partition member 22, and in addition, a bolt member 50 to be inserted through a through hole 49 of the base part 37 is screwed into the screw hole 43 of the block

body 38. Thereby, the base part 37 and the block body 38 are secured to the partition member 22. In the meantime, at an outer peripheral side of the projection part 44 of the block body 38, a seal member 51 such as an O ring or the like is fit.

The above-described shaft part 39 is provided with a pair of protrusion elements 52 at its rear end side, a screw hole 53 is formed on its end surface, and under the state that the holding plate 40 contacts the end surface, a bolt member 54 to be inserted through the holding member 40 is screwed into a screw hole 53. Then, at the side of the holding member 40 of the shaft part 39, a bush 55 configuring a bearing is externally fit. In the meantime, the bush 55 is composed of a cylindrical main body 55a and an outer guard part 55b projecting from this cylindrical main body 55a to the outer diameter side. The outer guard part 55b is fit into a cutout part 56 of the block body 38.

Then, the non-rotation side member S and the rotation side member R are sealed by a floating seal 57. This floating seal 57 is made of a first part 57a at the rotation side and a second part 57b at the side of non-rotation. The first part 57a is fit into a cutout part 58 for fitting of the block body 38, and the second part 57b is fit into a cutout part 60 for fitting of a ring-shaped supporting body 59 that is externally fit and secured to the shaft part 39. In the meantime, the first part 57a and the second part 57b are formed by sealing rings 61a, 61b, and O rings 62a, 62b, respectively. In addition, the shaft

part 39 is provided with a feeding path 63 for feeding oil to the floating seal 57, and a plug member 64 is disposed to its feeding port. Thus, under the state that the Swivel joint 34 is fit to the partition member 22 of the reamer main body 8, as shown in FIG. 3, its substantial part (specifically, a part omitting the protrusion elements 52) is approximately stored in the reamer main body 8.

In addition, as shown in FIG. 3, the above-described connection tool 35 has a pipe joint 65 to be attached to an end of the buried pipe 1 and a joint 66 to connect this pipe joint 65 with the Swivel joint 34. The pipe joint 65 is composed of a cap part 67 to be secured to the end of the buried pipe 1 and a ring part 68. In other words, the cap part 67 is composed of a main body part 67a and a cone part 67b, and the ring part 68 is projected from an end of this cone part 67b. The joint 66 has a protrusion element 69 to be inserted between a pair of protrusion elements 52 of the Swivel joint 34, and a pair of protrusion elements 70 in which the ring part 68 of the pipe joint 65 is inserted. In other words, a shaft part 71 is fit to the protrusion elements 52, and this shaft part 71 is inserted in a protrusion element 69 to be inserted between these protrusion elements 52. In addition, a shaft part 72 to be inserted in the ring part 68 of the pipe joint 65 is fit to a pair of protrusion elements 70.

Therefore, the Swivel joint 34 can swing against the

buried pipe 1 in a direction of an arrow X around the shaft part 72 and can swing in a direction orthogonal to the direction of an arrow X around the shaft part 71. Accordingly, by a combination of these swinging, the reamer 6 can be bent against the buried pipe 1. It is a matter of course that the reamer 6 can rotate around a shaft core of the shaft member 25 by the Swivel joint 34.

In addition, an outer periphery of the above-described coupled structure 7 is surrounded by a cover 74 for preventing intrusion of the earth and sand. In this case, the cover 74 is set so that its outer measure (it is approximately equal to an outer diameter measure of the buried pipe 1) is smaller than an inner diameter measure of the base end body 8a of the reamer main body 8. Then, a plurality of supporting elements 75 is provided to the partition member 22 at the side of the buried pipe 1, and one end portion (a front end portion) 74a of the cover 74 is injected in the inside of the reamer main body 8 so as to externally fit the supporting element 75. In this case, into an area where one end 74a of the cover 74 is superimposed on the supporting element 75, a bolt member 76 is screwed from an outer diameter direction, and this cover 74 is attached to the partition member 22. In the meantime, in this case, the bolt member 76 corresponds to the cutout part 14 of the reamer main body 8, and this makes it possible to screw this bolt member 76 from the outer diameter direction.

Then, under the state that the cover 74 is attached to the partition member 22, between one end portion 74a of the cover 74 and the base end body 8a of the reamer main body 8, a circular space 78 is formed, and on this space 78, the above-described emission port 36 is opened. Therefore, in the case of emitting the drilling fluid from the hollow chamber 23 of the reamer main body 8 via the emission port 36, the drilling fluid is discharged to the rear side without entering into the cover 74, so that the earth and sand at the outside of the cover can be discharged to the rear side. In addition, between other end portion 74b (an end portion at the opposite side of the reamer main body) of the cover 74 and the buried pipe 1, a gap 79 is provided. In this case, the gap 79 is disposed between the other end portion 74b of the cover 74 and the cone part 67b of the cap part 67 of the pipe joint 65. Thereby, even having the cover 74, the reamer 6 does not impair flexibility for the buried pipe 1.

As shown in FIG. 3, in the reamer device that is configured as above described, connecting the reamer 6 and the buried pipe 1 via the coupled structure 7 having the Swivel joint 34, the rod 3 that is used for forming the pilot hole 5 is connected to the rod connection part 24 of a front end the reamer device so as to carry out the operation for retracting back this rod 3. However, there are various soil types in the soil in which the buried pipe 1 is buried, and it is preferable that the reamer 6 suitable for the soil type is used. Therefore, according to

this pipe burying method, in prior to the burying operation, a soil type search of the burying place is carried out. Then, forming the reamer 6 suitable for the soil type, this reamer 6 is used.

In other words, as shown in FIG. 9, plural types of platy members 9 are provided, the platy member 9 suitable for the soil type of that burying place is selected, and the reamer 6 suitable for the soil type is formed by attaching this platy member 9 to the common reamer main body 8. In this case, on the basis of FIG. 9A, various types of platy members 9 are prepared such as one having a large thickness measure T as shown in FIG. 9B, one having a small width measure H as shown in FIG. 9C, one having the large thickness measure T and the small width measure H as shown in FIG. 9D, and further, one having a trapezoidal cross sectional shape as shown in FIG. 9E or the like.

Then, the soil type search of the burying place is carried out in advance and the platy member 9 suitable for the soil type is selected from among various platy members 9, and by attaching the selected platy member 9 as shown in FIG. 8B to the reamer main body 8 to which the platy member 9 is not attached as shown in FIG. 8A, the reamer 6 suitable for the soil type is formed. In this case, it is preferable that the Swivel joint 34 is attached. By the reamer device having this reamer 6, the rod 3 is connected with the buried pipe 1 so as to carry out the operation for retracting back this rod 3. In the meantime, the

number of the platy member 9 is three in FIG. 8B; however, it may be four or two. In other words, the number of the platy member 9 is arbitrarily increased or decreased and at least one is available. By changing the number of the platy member 9, it is also capable of changing the type of the reamer 6. Further, there is an angle suitable for the soil type considering a rotation rate of the reamer 6 and a thickness measure of the platy member 9 or the like as an angle of inclination of the platy member 9, and it is preferable that the platy member 9 is fixed on the reamer main body 8 at an angle suitable for the soil type.

Then, after mounting the reamer device, the rod 3 is retracted in a direction of an arrow B2 in FIG. 3 while rotating the rod 3 by means of the drill driving device 2. The earth and sand generated in this time is discharged from a space between the pilot hole 5 and an outer diameter of the rod by emitting the drilling fluid. In addition, a part of the drilling fluid comes round to a rear side to carry out a roll of a lubricant for the buried pipe 1. Then, the cut earth is confined in an inner wall of a hole at an outer periphery of the reamer 6 by rotation and retracting of the reamer 6, and thereby, the diameter of the pilot hole 5 is enlarged and the buried pipe 1 is retracted in the enlarged hole to be formed along the direction of the arrow B1. Then, when the rod 3 is retracted till the front end of the buried pipe 1 protrudes in

the starting pit P2, the retracting operation of the buried pipe 1 is completed.

In this case, the reamer 6 has flexibility for the buried pipe 1, so that the buried pipe 1 can be retracted by stable with stable controllability. In the meantime, when this retracting operation is completed, detaching this reamer device from the buried pipe 1, and pulling out the rod 3 from the starting pit P1, and burying respective pitches P1 to P3 again, the pipe burying operation is completed. In addition, when a buried distance is long, the pilot hole formation operation and the retracting operation of the buried pipe 1 may be repeated.

In the meantime, when the drilling fluid is emitted from the discharge port 18 as well as the described emission ports 15, the drilling fluid also operates as a lubricant for retracting of the buried pipe 1, a part of the drilling fluid penetrates in the walls of the enlarged hole and the pilot hole 5, and the rest thereof returns to the inside of the starting pitch P2 via the pilot hole 5 and remains there. This retained drilling fluid is sacked by a sacking device (not illustrated) and returns to the drilling fluid feeder 4, so that it is possible to use the drilling fluid again. Thus, the above-described drilling fluid is used for discharging the drilled earth and sand, lubrication and cooling of the oblique leading body (pilot head) or the reamer 6, and smooth promotion of the rod 3, and further, the bentonite fluid is used for preventing the earth

and sand from falling in a drilled hole and improving a pressure density for the wall of the drilled hole.

In this way, according to the above-described burying method, since the reamer 6 is suitable for the soil type of a burying place where the pilot hole 5 is formed, the earth can be drilled by a drilling amount in accordance with the soil type, and falling or the like of the earth and sand to the hole with the enlarged diameter after enlarging the diameter is evaded, so that the retracting operation of the buried pipe 1 can be smoothly carried out. In addition, by preventing the excess load and friction force from being given to the drilling blade of the reamer 6, it is possible to evade the damage of the reamer 6 or the like. Thereby, it is possible to stably use the used reamer 6 for a long time. In the meantime, the platy member 9 is composed of the platy member main body 9a and the curing processing part 9b, which is a surface (a surface at the side of the cutting blade 10 and a surface at the side of the outer surface 11) of this platy member main body 9a, so that the curing processing part 9b may be formed before mounting the reamer 6 on the reamer main body 8 or the curing processing part 9b may be formed after mounting the reamer 6 on the reamer main body 8.

In the meantime, even if the soil type search of the burying place is carried out, a real soil type may be different from a result of the soil type search, and thereby, the reamer

6 corresponding to the soil type is allowed to be formed at the burying scene. In other words, bringing the reamer main body 8 that is not provided with the platy member 9, and various types of platy members 9 as shown in FIG. 9, the platy member 9 suitable for the soil type is selected at the burying scene, and this selected platy member 9 is mounted on the reamer main body 8 by welding so as to form the reamer 6 suitable for the soil type. In this way, even if the soil type at the burying scene is different from the soil type that was searched in advance, by mounting the platy member 9 on the reamer main body 8 at the burying scene, it is possible to form the reamer 6 suitable for the soil type. On the contrary, if the platy member 9 is mounted on the reamer main body 8 before going to the burying scene, this reamer 6 cannot cope with the soil type that was searched in advance; however, it is possible to omit the mounting operation (the operation such as welding or the like) at the burying scene, and this makes it possible to shorten time of the burying operation. Further, since there is no necessity to bring a welding device or the like to the scene, an operator can easily move to the scene.

In addition, according to another embodiment, various reamers 6 are manufactured in advance, these plural reamers 6 are brought to the burying scene, and at the burying scene, the reamer 6 suitable for the soil type is selected and used. Also in this case, it is preferable that the Swivel joint 34 is mounted.

Therefore, since the reamer 6 suitable for the soil type of the burying place may be selected from among these various reamers 6 at the burying scene, by using the reamer 6 corresponding to various soil types, the diameter enlarging operation of the pilot 5 can be used, and this allows a stable pipe burying operation to be carried out. In the meantime, since the reamer 6 can be formed by mounting the platy member 9 on the reamer main body 8, by changing the platy member 9 to be mounted, various reamers 6 can be formed.

Then, according to the above-described reamer device, in the case of forming the reamer 6, by mounting a plurality of platy members 9 on an outer surface of the reamer main body 8 which is approximately shaped in a hollow cone shape, for example, by welding, the drilling part can be formed, so that the cutting machining for the groove machining can be omitted and thereby, a manufacturing cost can be decreased and machining performance can be improved. In addition, since the groove machining is not carried out, a wall thickness of the reamer main body 8 that is approximately shaped in a hollow cone shape can be made small so as to make the entire reamer lighter. Therefore, it is possible to make the detachment operation of the reamer 6 for the rod 3 in the pitch simple. In addition, the platy member 9 of the reamer 6 is excellent in abrasion resistance and it carries out an excellent function as the diameter enlargement tool for a long time because it is composed

of the platy member main body 9a and the curing processing part 9b, namely, the surface thereof. Further, since the above-described curing processing part 9b is formed by dispersion of the super hard particle, the curing processing part that is highly hard can be easily formed. If this curing processing part 9b is provided with the cutout parts 12 as in the above-described embodiment, the cutout parts 12 become grooves (spaces) for releasing earth and sand upon drilling so as to decrease a friction resistance.

Further, since the platy member 9 is arranged in a spiral shape, the reamer main body 8 smoothly rotates to reliably enlarge the diameter of the pilot hole 5. Thereby, the buried pipe 1 is smoothly retracted in this hole of the enlarged diameter. In addition, the concave grooves 13 are formed between the platy members 9, and this concave groove 13 becomes a discharge groove of the drilled earth. Furthermore, a plurality of emission ports 15 for emitting the drilling fluid is disposed in this concave groove 13, so that there is a gap between the emission port 15 and the inner peripheral wall of the pilot hole 5, the drilling fluid is easily emitted from this emission port 15 and the cutout part 14 is formed in the concave groove 13, and this makes it possible to discharge the earth and sand entered in the concave groove 13 from this cutout part 14 to the rear side and to effectively discharge the drilled earth. Therefore, a drilling capability of this reamer device

can be improved.

In addition, since the projection members 21 for preventing the earth and sand from entering in the emission ports 15 are disposed in the vicinity of the emission ports 15 of the reamer main body 8 at the front side of a rotational direction C, these projection members 21 can prevent the earth and sand from entering in the emission ports 15. In other words, upon enlarging the diameter of the pilot hole 5 while rotating the reamer 6, the projection member 21 becomes a protection wall against the earth and sand entering into the emission port 15 so as to evade clogging of this emission port 15. Thereby, the drilling fluid can be reliably emitted from respective emission ports 15, so that the function for cutting the earth can be stably carried out.

Further, since the substantial parts of the Swivel joint 34 of the coupled structure 7 are approximately stored in the reamer main body 8, even if there is the earth and sand that is not pushed into the inner wall of the hole, it is possible to prevent these earth and sand from entering into the Swivel joint 34. In other words, when pushing the buried pipe 1 into the pilot hole 5, the rod 3 is connected to the rod connection part 24 of the reamer 6, this rod 3 is drawn from the pilot hole 5, and in the reamer main body 8, the side of the narrow diameter becomes a traveling direction. Therefore, the earth and sand flow to the reamer main body 8 from its small diameter (narrow

diameter) side to the large diameter side, namely, they flow to the rear side, and this leads to prevent the earth and sand from entering in the side of the Swivel joint 34 of which substantial parts are approximately stored in the reamer main body 8. Thereby, the damage of the Swivel joint 34 can be evaded, and the reamer main body 8 is smoothly rotated so as to stably carry out the diameter enlargement operation of this reamer 6. In addition, since the Swivel joint 34 is approximately stored in the reamer main body 8, it is possible to make a gap measurement between the buried pipe 1 and the reamer main body 8 smaller, flexibility of the reamer 6 to the buried pipe 1 can be improved, and retracting capability of the buried pipe 1 can be improved. Further, if the gap measurement between the buried pipe 1 and the reamer main body 8 can be made smaller, an extra drilling opening toward the earth (the reamer connection hole) can be made smaller, and thereby, the construction time can be shorten by that much and further, it is possible to evade increase of the retracting resistance.

In addition, since the cover 74 for preventing intrusion of the earth and sand is disposed between the reamer main body 8 and the buried pipe 1 to be mounted on the reamer main body 8, by evading the intrusion of the earth and sand between this reamer main body 8 and the buried pipe 1, it is possible to evade increase of the retracting resistance of the buried pipe 1 due to the intrusion of the earth and sand into this reamer device.

Thereby, the retracting operation of the buried pipe 1 is not carried out by the excess retracting force but it can be carried out lightly. In addition, the damage to the coupled structure 7 due to the intrusion of the earth and sand can be prevented, and the diameter enlargement operation by the reamer 6 can be stably carried out. Furthermore, since the rotation side of the side of the reamer main body 8 and the non-rotation side of the side of the buried pipe 1 are sealed by the floating seal 57 in the Swivel joint 34, it is possible to configure an earth and sand intrusion prevention mechanism that is excellent in reliability and durability for a long time. Therefore, it is possible to extend a maintenance interval. Further, since the end portion of the side of the reamer main body 8 intrudes in this reamer main body 8, the cover 74 for preventing intrusion of the earth and sand can prevent the earth and sand from intruding from the end portion of the side of the reamer main body 8 of the cover 74 for preventing intrusion of the earth and sand into the side of the coupled structure 1, and since the gap 79 is provided between the end portion of the opposite side of the reamer main body 8 and the buried pipe 1, it is possible to secure flexibility of the reamer 6 for the buried pipe 1. In addition, in the retracting operation, the earth and sand flow to the side of the buried pipe 1 of this reamer device, so that by the gap 79 between the cover 74 for preventing intrusion of the earth and sand and the buried pipe 1, the earth

and sand or the like entered in the cover 74 can be discharged.

In addition, since the partition member 22 is disposed in the vicinity of the opening part at the side of the buried pipe 1 of the reamer main body 8, the reamer main body 8 is reinforced by this partition member 22. As a result, the reamer main body 8 is excellent in strength and the diameter enlargement operation of the pilot hole 5 can be stably carried out. In addition, since the partition member 22 is provided with the emission port 36 for emitting the drilling fluid entered in the hollow chamber 23 (a passage of the drilling fluid) of the reamer main body 8 to the side of the buried pipe 1, it is possible to prevent the earth and sand from accumulating at the rear side of the reamer main body 8 by the drilling fluid that is emitted from this emission port 36, and it is possible to evade increase of the retracting resistance of the buried pipe 1 by the intrusion of the earth and sand into this reamer device. Furthermore, by injecting rinse water from this emission port 36 and the emission port 15 after finishing the burying operation, the inside of this hollow chamber 23 can be cleaned. Particularly, since two cleaning holes 32 of relatively large diameters are disposed at the partition member 22, by injecting the cleaning water from one of the two cleaning holes 32 into the hollow chamber 23 and injecting the cleaning water from the other cleaning hole 32, the earth and sand or the like entered in the hollow chamber 23 can be discharged and

the inside of the hollow chamber 23 can be reliably cleaned. Therefore, without generating clogging of the emission port 36 and the emission port 15 due to the earth and sand or the like entered in the hollow chamber 23, the function for cutting the earth can be effectively carried out in the next burying operation using this reamer device. In the meantime, the emission port 15 is configured by the nozzle member 17 to be screwed to the screw hole 16 that is formed on the reamer main body 8, so that even if the clogging is generated in this emission port 15, by detaching the nozzle member 17, it is possible to easily remove the clogging.

The specific embodiments according to the present invention are described as above, however, the present invention is not limited to the above-described embodiments and various modifications are allowed in a scope of the present invention. For example, in the case of forming a reamer suitable for the soil type, if the reamer main body 8 is standardized, the cost can be reduced and the stock control becomes easy; however, a plurality of reamer main bodies 8 having different shapes is also available. In this case, the hole diameter and the number of the of emission ports 15 of the reamer main body 8 may be different. In addition, depending on the soil type, the platy member 9 has no curing processing part 9b. Further, in the case of selecting the reamer 6 suitable for the soil type from among various reamers 6, according to

the above-described embodiments, the reamers 6 having different platy members 9 are used, however, when the reamer 6 uses the super hard chip 90 as shown in FIG. 7B, by changing this super hard chip 90, various types of reamers 6 can be formed, so that the operator may bring the reamer 6 that is formed in this way to the scene. In the meantime, depending on the pipe burying place, the rod 3 is made to penetrate through the inclined surface and the rod 3 is made to project from the inclined surface. Therefore, on the burying operation, the penetration pit P1, the starting pit P2, and the attainment pit P3 or the like may be omitted. In addition, as the ground boring machine to be used, the drill driving device 2 and the drilling fluid feeder 4 are configured separately, however, these devices may be integrally configured.